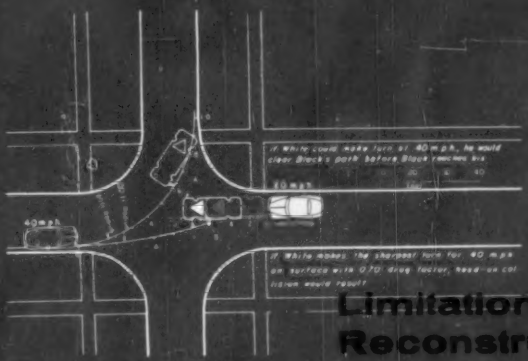
TRAFFIC DIGEST and Review

TRAFFIC INSTITUTE / Northwestern University

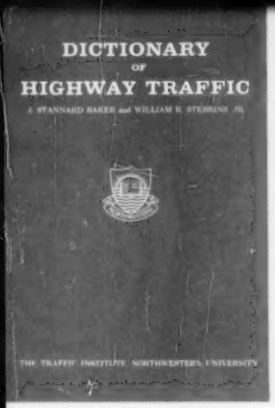
DECEMBER 1960

Recognition of Collision Course: PAGE 4

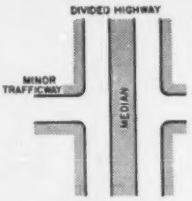
A Library for Traffic Officials: PAGE 9



Limitations on Accident Reconstruction: PAGE 20



intercepted crossroad (**21**) A crossroad at an intersection where a median strip on the major traffic-way continues through the intersection, thus barring direct crossing by vehicles on the crossroad.



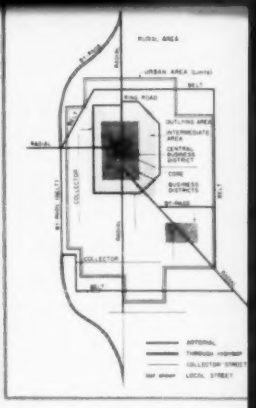
INTERCEPTED CROSSROAD

interchange (**2**, **19**, 3, 18) A system in conjunction with a grade separation or *grade separations* of interconnecting *roadways* providing for the interchange of traffic between two or more *roadways* or *highways* on different levels.

Source **3**: "A(n) (intersection) [junction] grade separated with one or more turning *roadways* for travel between (intersection) [junction] legs."

Source **18**: "A system of interconnecting *roadways* with a grade separation or grade separations providing for the interchange of traffic between two or more roadways or highways."

The definitions are not in conflict. Interchanges must have one or more *grade separations* and *roads* connecting the two levels.



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Briefly...

HIGH SCHOOLS last year used 13,805 cars for driver education. Of the total, 8,415 cars were loaned free by automobile dealers and 1,105 by other sources. In the last seven years the number of cars which dealers have loaned to schools for practice driving instruction has more than doubled, according to the Auto Industries Committee on Highway Safety.

* * *

IN SAN FRANCISCO, police cooperated with the Call-News Bulletin to select a COOL—Careful Of Other Lives — teenage driver each day until 10 were selected. A police officer followed teenage drivers and observed their driving habits. The 10 drivers were rewarded by being guests for dinner, and each received $5.00. With their dates they were taken to Winterland and the Ice Follies.

* * *

DRIVER EDUCATION courses to meet the needs of 53,000 displaced persons and many other foreign-born residents are being conducted by the Cleveland Automobile Club and the Women's Division of the Mayor's Traffic Safety Education Committee. Lessons include the English required to read highway signs and warnings, safe driving practices, traffic laws and customs, and knowledge about owning automobiles. The material is translated into Polish, Hungarian, German, Slovak, Italian, and Spanish. Bilingual teachers lecture voluntarily.

* * *

A SUBURBAN New Orleans husband and wife who work at different ends of the city leave home each morning with the husband driving. At an intersection where either can make good bus connec-

(Continued on Page 3)

TRAFFIC DIGEST and Review

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Editorial

HOW GOOD IS YOUR TRAFFIC PROGRAM?

LIKE THE OLD bromide about the weather, how often does anyone do more than just talk about a police traffic program? Further, when people talk about a traffic program, how often are they merely discussing a plan, a plan which is never really put into effect?

The term "program," of course, implies more than a blueprint or outline; it includes the action necessary to implement the planning.

We suspect that a lot of traffic planning goes on which is never productive of anything useful. This may be due in part to shortages of such things as manpower and equipment—in other words a lack of sufficient funds. But it may be that a lot of planning is fruitless simply because it is inappropriate to the real situation; that is, there is no real connection between the plan and the kinds of action needed to convert it into an effective program.

It should be remembered that "traffic program" is also a relative term. It may refer to the coordinated activities of several agencies of a community in its effort to cope with the traffic problem. In this sense, "program" would involve traffic engineering, education of the general public, and traffic court practices, as well as police traffic supervision.

However, for the present purpose, let us limit the application of the term to those activities of a police department which might properly be called a traffic program.

The transition from planning for police traffic supervision to actually implementing the plans in an effective traffic program depends upon a number of administrative principles and guides which, through the years, have proved to be realistic and efficacious.

At the Traffic Institute, the most useful of these have been systematically arranged in the form of a questionnaire or checklist against which the present traffic program of a department may be evaluated.[1]

For example, under the general heading of whether a program is being adequately administered: "Do you fully appreciate the role of the police in traffic safety as representing only one of the responsible agencies, but one which must provide the spark of leadership and stimulation when other 'responsible' agencies are in default?" Again, "Have you developed a specific plan of action, coordinated with the plans of other agencies, to reduce the incidence of accidents through police supervision?"

As to the question of personnel: "Is your personnel strength up to authorized limits; does your recruitment and selection system guarantee that you are getting the best men available? Are the best men presently available good enough for your program?"

The checklist goes into considerable detail on the subject of administrative control of specific operations in police traffic supervision. For example, in the area of traffic accident investigation: "Do your investigations go deep enough to identify *causes* as distinguished from hazardous violations, or simply adverse weather and road conditions? Are your investigators fully expressing their own opinions as to the causes of accidents?"

Obviously this is only a sampling of the wide range of administrative controls, techniques, and procedures which may be introduced into a departmental traffic program to make it more effective in reducing accidents.

Our purpose here is to point out that there are recognized and proven guides for setting up and implementing a realistic traffic program; that these may be adapted and applied to a particular departmental setting with fruitful results; that "police traffic program" is not always or necessarily an empty phrase. ★

1. Editor's Note: A complete checklist for evaluating the effectiveness of a departmental traffic program will appear in the January issue of *Traffic Digest and Review*.

Briefly . . .

(Continued from page 1)

tions to the office, they take turns keeping the car. When it is the wife's turn, she slips under the wheel as her husband leaps out. Often heavy traffic prohibits curb parking. One day the wife was in such a hurry to get to work that she leapt out of the car and ran for the bus. It was her turn to take the car. Her husband also leapt out and ran for his bus. A police officer looking for the cause of a traffic jam, found the car abandoned in the middle of the street.

* * *

THIRTEEN pedestrians were injured and eight killed in Virginia traffic last year while lying in the roadway. None was ruled a suicide. Some victims might have fallen, others might have been struck by previous hit-and-run drivers. None was under 20 or over 55 years old.

* * *

A MOTORIST in Canton, Pennsylvania, who had his driver's license suspended for speeding got a horse and buggy. From the rear of the buggy he hung a large sign which read: "Drive slow, or you will ride this way."

* * *

NOT ONE Miami child was hurt crossing a school zone street in the last year, following a change in the city's protection system. Crossing guards were replaced by traffic lights which are turned red by pedestrians. Fifteen miles an hour speed limit warnings were replaced by "Dear Crossing" signs. The whole crosswalk, signs, and signal lights were painted fluorescent red-orange with a glow visible for 600 feet.

* * *

THE SURPLUS in the Highway Trust Fund was increased to almost $150 million as receipts ran ahead of expenditures, the National Highway Users Conference states. On August 31, 1960, the Highway Trust Fund had $149,583,621 on hand, with no funds invested. Treasury Certificates amounting to $1,335,000 were retired in August.

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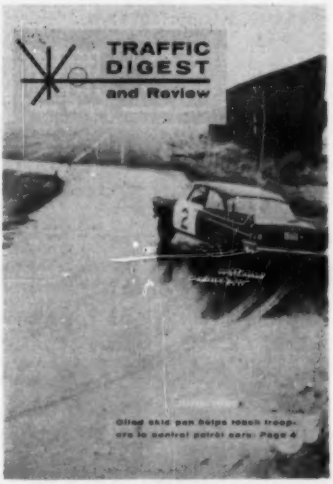

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RECOGNITION OF COLLISION COURSE IN TRAFFIC ACCIDENTS

Traffic Institute research has revealed that drivers' failure to recognize an impending collision is a frequent cause of accidents

By H. LAURENCE ROSS
New York University

OVER THE COURSE of the last three years, a research team at Northwestern University, consisting of a social scientist, a physician, and an engineer has been conducting an intensive study of traffic accidents. This work, Experimental Case Studies of Traffic Accidents, is a thorough investigation of common automobile accidents. The data collected for every accident included detailed measurements of the accident scene and intensive interviewing of each participant. This report presents a tentative analysis of certain kinds of accidents from the point of view of social science.

Among the 43 accidents studied, a large proportion was found to involve lack of awareness of an imminent collision on the part of one or both drivers. Either a driver did not see the other vehicle until it was too late to act effectively, or, if the vehicle was perceived in time, its course was incorrectly predicted. This failure to recognize an impending collision appeared so often that a special review of the data was conducted in order to document the problem and to suggest ways in which accidents involving failure to recognize a collision course might be reduced.

When two vehicles are on a collision course, one or both of the drivers must see the other vehicle and predict its course in order to avoid an accident. Seeing the other vehicle is the more fundamental problem, because, obviously, prediction of a vehicle's course cannot be made unless the vehicle is seen. Furthermore, the other vehicle must be seen *in time*, before it is too late to act.

Failure to see the other vehicle was

EDITOR'S NOTE: The author was formerly the social scientist member of the team of scientists conducting field accident investigations for the Traffic Institute research project "Experimental Case Studies of Traffic Accidents."

common in the accidents studied. This was termed delayed perception. Its presence as a factor in an accident was sometimes stated by interviewed drivers in such terms as "I didn't see him until he hit me." In other cases, the research unit believed that delayed perception was a factor because conditions at the scene of the accident or in the interviews appeared likely to have generated delayed perception at the time of the accident.

Causes of Delayed Perception

Delayed perception seems to have two major causes. These are impediments to vision and inattentiveness. Where impediments to vision existed at the time of the accident, the driver's view of the other vehicle was deficient or was blocked, and the vehicle was not readily visible. Where inattentiveness existed, the vehicle was readily visible, but the driver was directing his attenion to other things in the environment and was not conscious of the collision course.

Impediments to vision were found within the person himself, within the vehicle, and within the environment. Inadequate vision was found in at least one case. Within the vehicle, foreign material on the windshield such as dirt, rain, tree drippings, and ice was found to have contributed to delayed perception. Elements of vehicle design were also noted, such as opaque members of the body and accessories like the dash-mounted rear-view mirror.

The environment provided a wide variety of impediments to vision. In at least seven cases, cars parked near intersections blocked the view. Other vehicles, for instance those waiting to make left turns, sometimes performed the same function. A major category of impediments to vision consisted of items such as trees, utility poles, bushes, fences, buildings, and signs located close to the pavement. Finally, sun, rain, and snow under certain conditions interfered with the driver's ability to see.

The effect of inattentiveness was similar to vision impediments in causing delayed perception. In some cases, drivers failed to look to the rear when alighting from a parked car. There was at least one case of a driver so preoccupied with his own thoughts that he failed to see an approaching car. Within the vehicle, the activity and conversation of passengers was a distracting influence, as was the necessity to check instrument panels. Outside of the car, unusual sights and sounds distracted the driver's attention from the road ahead, and in some instances a collision course with a vehicle in one direction served to distract attention from a collision course with a vehicle approaching from a different direction.

A special case of distraction is inattentiveness to the situation at the rear of the vehicle. A quarter of the accidents studied were rear-end collisions, and in a majority of these drivers were not aware of the collision course until they were hit.

As stated above, delayed perception is a fundamental problem in driver recognition of a collision course. However, even with a clear view of the other vehicle and plenty of time to take evasive action, drivers failed to act because they were unaware that they were on a collision course. The reason for this is that they did not predict the eventual path of the other vehicle. This source of accidents is termed erroneous prediction.

Predicting Path Difficult

The prediction of the path of a vehicle is very difficult for two reasons. First, vehicles can accelerate, brake, and change direction with relative ease while giving little or no advance warning of these maneuvers to other drivers. Second, the behavior of each driver depends on what he thinks the other driver is going to do, but neither can be sure of the other's actions in advance, so both must guess. Since accidents are relatively rare events, it follows that this difficult job must be performed successfully in most instances, but the occasional cases of failure are important causes of accidents.

In order to predict the course of another vehicle, a driver has three types of information available. He has, first,

what he can see in the immediate situation, including the state of the roadway, the distance and speed of the other vehicle, and obstacles and traffic control devices in the environment. A second type of information is stored knowledge, including physical principles and driving norms. The physical principles allow the driver to estimate the range within which a change of course is possible. For instance, it is unlikely that a vehicle approaching on an intersecting road at 60 miles an hour and at a distance of 100 feet could be stopped before entering the intersection, even though the driver of that vehicle was completely intent on making the stop and used maximum braking. The driving norms are generalized expectations concerning both how drivers should drive and how they do in fact drive. For instance, if a vehicle approaching from a considerable distance on an intersecting road is known to be facing a red light at the intersection, a likely expectation for the driver making the prediction is that the competing vehicle will stop for the light.

Third Type Is Communication

The third type of information that is potentially available to help in prediction is communication, or messages from one driver to another. Examples are the standard mechanical signals indicating right and left turns. Correct prediction of the course of another vehicle will be possible if the driver sees all relevant aspects of the environmental situation, if his estimates of the physical possibilities of the other driver's action are correct, if his normative expectations concerning the other driver's action are legitimate and are not violated, and if communication between the drivers is accurate and adequate.

Case Studies material revealed several types of predictions of vehicle course that were violated in accidents. In some case histories the expectations were made explicit in the interviews by such statements as, "I thought he would stop." More commonly, it was necessary to construct the expectation by studying the attempted evasive action closely. The statement of these expectations must be considered suggestive rather than demonstrative.

Apparently the most general and important kind of prediction made by drivers with respect to the behavior of others is that they will proceed at the same speed in the same general direction and in the same lane of the road. Predictions of this kind are called quasi-physical, because they are formed by simple physical extrapolation of an observed course. Specific instances of this type of prediction found in Case Studies accidents were: (a) a driver will not make a sudden stop; (b) a driver will stay in his own lane; and (c) a turn will not be made unless signaled in advance.

A second category of predictions found in the Case Studies depended on communication. Signals received from other drivers were interpreted as indicators of specific types of behavior. For instance, it was believed that vehicles emitting a standard signal for a turn would not proceed straight ahead, but would turn at the nearest intersection.

Traffic Control System

A third category of predictions depended on the traffic control system. Specific examples of this were: (a) vehicles approaching an intersection with a stop or yield sign will slow or stop to permit vehicles on the favored street to pass through the intersection; (b) vehicles approaching an intersection where there is a red or amber traffic light will stop; and (c) vehicles will move on a green signal, or, by extension, will not stop when a green signal is about to come on.

Other predictions depended on specific aspects of various traffic situations. For instance: (a) traffic from a minor road will exercise caution before entering a major road; (b) pedestrians will yield to vehicles when not in a crosswalk, and vehicles will yield to pedestrians when in a crosswalk; (c) vehicles on a given road will move together and in opposite directions at the same time; (d) in any situation, traffic will move at speeds within an appropriate range; (e) vehicles

will not back up in a traffic lane; (f) doors of parked cars will not be opened into traffic; and (g) traffic from the rear will stop, slow, or pass, depending on the possibilities.

It would appear that assumptions such as these are in general valid and realistic and help drivers in taking action to avoid accidents. At times, however, they can be misleading. One situation that can arise to confound these predictions is that in which a prediction of behavior is made, but important aspects of the situation are unknown to the driver. For instance, a turn signal may not be seen, or a traffic light might be subject to mechanical failure, or a driver from a different state misinterprets hand signals.

Variant Action a Factor

A second situation that confounded predictions was variant action. Here two or more predictions legitimately could have been made, but the wrong one was chosen. As an example, consider that a car approaching a traffic light in a yellow phase may legitimately proceed through the intersection, or stop. A driver observing this situation and making a prediction about it runs a high risk of finding it invalid. Unless he allows for the possibility of either course of action, there is a good chance of an accident. A third condition confounding predictions was deviant action. In this situation a driver did something that was illegitimate and improbable and thus not expected by others. Examples are failure to turn when the turn signal is activated or failure to stop at a signal. Even the best driver cannot always allow for the possibility of deviant action, if traffic flow is to be efficient.

With the preceding analysis in mind, a few suggestions can be offered concerning accident prevention. A specific and extensive discussion of accident prevention is available in a separate report of the Case Studies project.

Perhaps the most practical and least costly approach to avoiding accidents similar to the ones discussed here would be the elimination of fixed impediments to vision. The legislator, the traffic and highway engineer, and other agents of the community concerned with traffic safety are in a position to eliminate such items as signs, bushes, trees, poles, and, above all, vehicles parked near intersections, as these were so frequently found to play the role of vision obstructions. With a 30 mile per hour speed limit, such items should be prohibited within 100 feet of intersections. While outstanding permanent obstructions are often noticed and removed as found on many road and street systems today, the frequency of these obstructions and the major role they appear to play in accidents, coupled with the relative ease of eliminating them, suggests that much more should be done. Moving impediments are much more difficult to deal with and are probably best managed through driver education stressing the danger of closeness to other vehicles in intersections.

Most impediments to vision in the vehicle have been eliminated with modern vehicle design, but the rear-view mirror in many cars is still a hazard to forward vision, as are decorations like religious statuettes, rubber dice, and other adult toys encountered in the Case Studies investigations. One might also consider the possibility that vehicle inspection stickers and parking stickers contribute to accidents. The placement of such items in the vehicle should be regulated by law. Driver licensing vision examinations, repeated periodically, may be the way to control similar factors in the individual.

More Difficult Problem

Attentiveness is a much more difficult problem. A first need is research designed to estimate the likelihood of hazards from various directions. Results of this research, along with estimates of the possibility of doing things about hazards in these directions, should be used to work out a desirable scanning pattern, which must then be taught through driver education. Some systems of driver education have made a beginning in this direction and might be made more effective with a basis in scientific research. Another approach would be to eliminate sources of distraction wherever possible.

Typical examples are flashy advertising signs in the road and complicated and obscure instruments in the vehicle.

Probably the most difficult category to deal with is erroneous predictions. Most of the driver expectations cited above are supported by law, and they appear to be substantiated by driving experience in countless common situations. They are the basis of efficient traffic flow and to question them too strongly might drastically reduce the efficiency of the flow.

The effect of insufficient information might be reduced by techniques similar to those recommended for impediments to vision and by standardization of laws and administrative practices between jurisdictions.

Research designed to estimate the probability with which various variant and deviant courses of action actually occur would be of help to drivers in anticipating a vehicle's course. Perhaps the development of a more versatile signal system, allowing drivers to specify to each other which of several possible and legitimate courses of action they plan to take, and to what degree, would be helpful. In some situations a feed-back signal, acknowledging receipt of a message, would be useful. The bulk of responsibility for minimizing the problems that variant and deviant action create for expectations must go to driver training, which should emphasize the hazards of commitment to expectations and the benefits of a good strategic position. This is what is commonly taught under the term "defensive driving."

The safety field tends to be beguiled by explanations of accidents that offer easy solutions—more law enforcement, more intensive vehicle inspection, lower speed limits, and the like. It is unlikely that solutions such as these would have eliminated many of the accidents studied in this project. Safe driving requires above all the prompt perception of hazards and the accurate prediction of their courses. The imagination and ingenuity of people in safety work must be turned to the manipulation of the driver and his total environment in order to achieve this goal. ★

Film Tells How to Handle Mental Cases

That the police officer's line-of-duty handling of a mentally disturbed person can be performed with humanity and safety is the message of *Booked for Safekeeping,* a new training film prepared by the Louisiana Association for Mental Health in collaboration with the National Institute of Mental Health and with the assistance of the New Orleans Police Department.

The film was planned and developed by Dr. Lloyd W. Rowland, director of the Louisiana Association, and produced by George E. Stoney.

The new motion picture comes as a film sequel to the booklet *How to Recognize and Handle Abnormal People* prepared in 1952 and recently revised by the Louisiana Association for Mental Health. The phenomenal demand for this booklet from police departments and police training schools suggested that police officers were definitely interested in refining their approach to disturbed persons, and thus the idea of a training film was conceived.

Booked for Safekeeping in no way attempts to idealize the physical environment in which mentally disturbed persons are taken into custody; instead it gains documentary realism from its depiction of a typical setting in which a nonprofessional cast of police officers and local residents enact the film roles. In scene after scene, the film hammers home its theme, namely: *Treat every person as if you were to handle him again, as indeed you may.* In effect, this theme phrase covers the basic points of correct police handling of excited persons — calmness, candor, consideration, honesty, psychological rather than physical deterence, reassurance, and gradual release from restraint.

The film will be available on loan from the Audiovisual Division of the U. S. Public Health Service's Communicable Disease Center, Atlanta 22, Georgia, or it may be purchased from United World Films, 1445 Park Avenue, New York.

A Library for Traffic Officials

The Transportation Center Library is a national source of information on traffic subjects

WHEN the Institute of Lightweight and Aircraft Construction in Vienna wanted help in establishing a transportation documentation center, it asked the library of the Transportation Center at Northwestern University.

When the Chicago Area Transportation Study wanted a map of horse-drawn car routes in the Windy City, it asked the library of the Transportation Center. And they got the map.

When the Washington State Patrol wanted help in starting a small library within the detachment, it asked the library of the Traffic Institute, Northwestern University, Evanston, Illinois.

These are only three of the requests from all over the world answered by the combined, 81,000-item library of the Transportation Center and Traffic Institute. Miss Marianne Yates and her staff answer hundreds of requests each year.

The library is a quarter-century old, having been organized as part of the Traffic Institute in 1936. The Transportation Center began its library services shortly after its organization in 1956. Each library was unusual, so when the Center and Institute administrations merged in September, 1959, the result was a unique traffic-transportation library.

The library is unique because the Traffic Institute emphasizes administration and the Transportation Center

economics and management. Most libraries in these fields emphasize engineering, Miss Yates said.

"During the past year's operation of the combined library," Miss Yates said, "we have seen a correlation between the transportation industry and traffic administration and law enforcement. Traffic administration at all levels of government has a direct influence on the national transportation network. This is most noticeable in our metropolitan areas which are the most congested and yet must serve as distribution embarkation centers for goods and people."

The Transportation Center's library has grown in three years from a dictionary and a subscription to *Traffic World* to substantial size by the gifts of railroads, airlines, water shippers, motor carriers, banks, container companies, steel manufacturers, chemical companies, and individuals.

Gifts range from thousands of items of railroadiana given by Howard Greene of Boston, a Northwestern University alumnus, to several hundred items relating to the St. Lawrence Seaway given by the late Mrs. Clara Ingram Judson.

In 1957 the library purchased 13,000 volumes on economics from the John Crerar Library, Chicago, and some 2,000 volumes from the Simmons-Boardman Company. The latter purchase included almost the entire run of *Railway Age* magazine, back to 1870.

Much valuable material has been acquired from surplus of such government agencies as the Civil Aeronautics Board and Interstate Commerce Commission. In cases where it has been necessary for research, such as data on the merchant marine, the library has bought photocopies of statistical series only available in files.

Last year the library added 53,800 items by gift and purchase, bringing its volume to 81,000 books, pamphlets, and photo-copies. It receives 891 periodicals.

"None of these figures is meaningful unless related to the services the library can offer to its patrons," Miss Yates said. "We never turn down a request. If we can't answer the question, we'll give alternate sources where inquiry may be satisfied. We are glad to make photo-copies at a nominal fee or loan materials."

Each month the library issues a list of "Current Literature in Traffic and Transportation." This covers books, pamphlets, periodicals, and Transportation Center and Traffic Institute publications. It also includes publications of all government agencies dealing with traffic and transportation.

"The library," Miss Yates said, "serves not only our own Traffic Institute and Transportation Center as well as Northwestern University, but also educators and researchers at other institutions and executives in government and industry. It is a national source for comprehensive and reliable information on traffic and transportation." ★

Hoffman Award To Denver Jurist

The Paul Gray Hoffman Award for distinguished professional services in highway safety has been conferred upon Judge Sherman G. Finesilver of the Denver, Colorado, Municipal Court.

The award was presented at the United Nations offices of the donor, Paul G. Hoffman, former president of Studebaker Corporation and a noted pioneer in the highway safety movement. A former ECA Administrator, he is now serving as managing director of the United Nations Special Fund.

The purpose of the award is to recognize and encourage the work of educators, enforcement officials, engineers, researchers, organization staff members and others who make their careers in traffic safety.

Judge Finesilver was honored for his leadership in raising the standards of traffic court administration in his city; for creating a model driver improvement school; and for other contributions to reduce the traffic accident toll.

NOTES ON

BOOKS

CURRENT TRAFFIC LITERATURE

Reviewed by the TRANSPORTATION CENTER LIBRARY

Status of Driver Education in the United States; A study of courses as described by state and local school systems in response to special inquiry. Norman Key, National Education Association, 1201 16th St., Washington 6, D.C., 1960. 76 pp. $2.00.

Mr. Key provides an excellent description and analysis of high school driver education in the various states. Originally a Ph.D. dissertation at the American University, it was revised for publication by the NEA. The book is designed to ". . . describe for use by school systems the administrative and instructional practices, the professional personnel and course standards, and the scope of driver instruction."

Solutions to the acute problem of providing instruction for all eligible students in a crowded curriculum and at minimum cost are suggested by the use of teacher assistants, driving simulators, and instruction during summer vacation periods.

Mr. Key describes teacher preparation programs for state certification requirements and outlines a minimum program of instruction to qualify young people for reduced insurance rates.

Especially valuable are Mr. Key's recommendations toward extending and improving driver education programs. A useful bibliography covering material through 1958 is appended.

Roads and Their Traffic; An introduction to traffic engineering by 13 contributors. Ernest Davies, editor. New York, Philosophical Library, 1960. 352 pp. $12.00.

Thirteen contributors from five countries describe the diverse functions of the traffic engineer, the methods he employs, and the techniques he applies, together with practical examples. Each writer was chosen for his proficiency in a specialized field; each writes simply enough to be understood by the layman but the book is comprehensive enough to be useful to the student and the technician. Each chapter is followed by a list of references. A glossary of technical terms used in the field of traffic engineering is appended.

Some of the main subjects covered are: National and regional highways, both in Great Britain and continental Europe; urban streets and traffic control; parking; road signs and lighting; traffic research, and safety and administration.

Although the book emphasizes conditions in Britain and the continent, it will be a useful addition to the growing literature on traffic engineering.

Use of Dogs in Police Work. U. S. Conference of Mayors. 1707 H Street N.W., Washington 6, D.C., March 1960. 6 pp. 25c.

This is a brief summary of important points to be considered in setting up a K-9 corps. The breed of dog most desirable, training, selection of police officers to work with the dogs, and the city's liability for acts of dogs are discussed. This is followed by a city-by-city description of K-9 corps in use. As of the date of this report, 18 cities are using dogs, with all but one reporting excellent results: ". . . One dog is equal to one patrolman . . .", ". . . used extensively in high-crime areas . . .", ". . . dogs have found criminals hiding in warehouses, etc., after men were unable to do so." ★

TRAFFIC TRAINING CALENDAR

JANUARY 9-FEBRUARY 10, Introduction to Police Management; Traffic Institute, Evanston, Illinois. Management principles as adapted to police service are discussed in detail in this five week course. Includes methods of planning; organization of activities; staff work and how it can help police administrators, and the development and use of policies and procedures as performance guides.

JANUARY 9-20, Supervision of Police Personnel; University of California, San Francisco, California. Western Region Police Traffic Training Program conducted by the Traffic Institute in cooperation with the International Association of Chiefs of Police.

JANUARY 23-27, Western Region Traffic Court Conference; University of California, Berkeley, California. For judges, justices of the peace, prosecutors, lawyers, court officials, and selected police officers. Held in cooperation with the Traffic Institute and the American Bar Association Traffic Court Program.

FEBRUARY 9-10, Southwestern Region In-Service Training Conference for Graduates of the TPA Training Program and their Chiefs. Host: Arizona State Patrol. Location: Phoenix, Arizona. Discussion centers on current traffic problems and their solutions.

FEBRUARY 13-MARCH 3, 1961, Personnel Management for Police; Traffic Institute, Evanston, Illinois. A comprehensive treatment of such personnel management techniques as recruitment; examinations; training; assignments; and promotion and performance evaluation. Designed to aid officers administering personnel policies within the framework of existing local or state laws.

Driver Training Awards Given

Eleven states and the District of Columbia were honored recently for their 1959-60 high school driver education programs.

Cited in the 13th Annual National High School Driver Education Award Program were:

Achievement Award: Arizona, Delaware, Florida, Iowa, Kansas, Michigan, North Carolina, Utah.

Progress Award: District of Columbia, Illinois, Indiana.

Progress Award (for private and parochial schools): Delaware, Texas, Utah.

Michigan was voted a special award for providing driver education in the state's public schools for non-public school students.

Forty-eight states and the District of Columbia participated in the 1959-60 Award Program, which is sponsored by the Insurance Institute for Highway Safety. The Award Program is the medium recognized by the President's Committee for Traffic Safety as the annual measurement of driver education progress.

Seventy-three per cent (12,600 of 17,227) of the nation's public high schools covered in the 1959-60 report offered a course in driver education. Fifty-six per cent of the schools provided a "qualifying course," i.e., one consisting of 30 clock hours of classroom instruction and six hours of practice driving, taught by teachers who have met specific requirements.

Of the 2,085,734 "annual eligible students" (those reaching legal driving age during the year) enrolled in the public high schools, 1,212,992 or 57 per cent took a course in driver education in the 1959-60 school year. A little more than 770,000 or 34 per cent took a "qualifying course."

Twenty-nine states and the District of Columbia reported on private and parochial high school driver education programs for the 1959-60 school year.

KNOW THE LAW

Arrest for Offenses Committed in the Presence of an Officer

BY ROBERT L. DONIGAN, General Counsel
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The Traffic Institute

FROM time to time this department has presented articles dealing with various aspects of the laws of arrest,[1] but none has discussed the subject of arrest without warrant for offenses committed "in the presence" of an officer, or "on view," as the authority is expressed in different statutes. From the days of the common law until the present, it has been a part of the recognized authority of an officer of the law to make arrests without a warrant for offenses *committed in his presence*.[2] It is the purpose of the present article to discuss some of the various aspects of this authority as it relates to an arrest without warrant for the commission of a misdemeanor in those states limiting the authority to such offenses committed "in the presence."

As will be seen from the cases cited later in this article, the authorities in those jurisdictions quite uniformly stress the point that an offense, i.e., the commission of a prohibited act or the failure to perform a commanded act, must take place in the presence of the officer if it constitutes only a misdemeanor, and this is accepted as elementary law in this field. However, only a few cases have involved situations in which such an offense actually is committed in the presence of the officer but the guilty party is elsewhere at the time. In other words there are certain instances in which one may commit a crime *in absentia*. What is the police authority to arrest without a warrant in such cases of criminal responsibility where it is but a misdemeanor involved?

A recent decision of the Supreme Court of New York County, New York, involved a situation where a city police officer was sued for false arrest and false imprisonment. The officer had discovered gambling equipment in a hotel room occupied by one Millea, who was absent at the time, but was later arrested by the officer without a warrant under a New York statute relating to the possession of gambling equipment. As defense to Millea's suit, the officer alleged the finding of the gambling equipment and that the arrest was based on a reasonable and probable cause in the discharge of his duties as a police officer. The case came before the court on Millea's motion to strike this defense for legal insufficiency in that it did not allege commission of the offense in the presence of the officer. The court agreed with Millea's contention that "absent a warrant, a police officer may only arrest a defendant charged with a misdemeanor if the crime is committed in his presence." Thus the question was whether, in view of the crime charged, it was committed in the officer's presence.

After setting forth the terms of the statute providing that one is guilty of being a "common gambler" if he is a person who occupies or uses a place or room or knowingly has in his possession "any writing, paper or document" used in the game commonly called "policy," etc., the court pointed out that *possession* of policy slips or control of the place where they are found is sufficient to constitute the offense. Possession implies

1. See *Know the Law*, (1958), pp. 222-282; Traffic Digest & Review, May, 1960, "Search and Seizure Incident to Traffic Arrest," and June, 1960, "Right to Forcibly Enter Building to Make Arrest."
2. For modern innovations restricting this power in some traffic cases, see Uniform Vehicle Code, (1956), secs. 16-104 to 16-115, and statutes patterned thereafter.

physical possession, actual custody or control of personal property capable of being physically held, the judge said, "but, in my view, it is not required that possession be on the accused's person. And, indeed, as I picture it, control may include a potential, as well as an actual, personal assertion of active dominion. . . . In the circumstances, when one is accused of being in control of some place or in possession of some thing, and is arrested on the basis of that accusation, it suffices that the control or possession be that of the accused to justify his arrest for the alleged commission of the misdemeanor, notwithstanding that the accused, at the time, be not personally present at the place controlled or have on his physical person the contraband object, with possession of which he is charged."

* * *

"In the light of the concepts that I have hereinbefore presented as to possession and control being capable of being a continuing offense, and of being capable of commission in the physical absence of the accused, it is my opinion that sufficient is set forth in the defense as pleaded from which a reasonable inference could be drawn that the alleged crime was committed in the presence of the police officer, as that term is used in an action for false arrest and imprisonment arising out of that alleged commission. To put it another way, I am of the opinion that an arrest for the misdemeanor of control or possession may be justified without a warrant, notwithstanding that the accused is not personally present at the place involved or does not have on his person the object in question—since it is not necessary for him to be personally there or personally to have the forbidden object to be guilty of the misdemeanor charged. By so much is the rule, requiring that the alleged crime be committed in the presence of the arresting officer, relaxed. In short, *if the accused need not be personally present to be guilty, his guilt need not be personally observed to justify his arrest.*"[3] (*Emphasis supplied.*)

Other instances of illegal possession of various articles come readily to mind in which actual personal custody is not required, such as burglar's tools,[4] possession of liquor,[5] etc. Thus the offense of illegal possession of liquor was committed in the presence of an officer admitted to the home by defendant's wife, he being in another part of the house asleep at the time. His later arrest without a warrant was held legal.[6] In a California case two police officers walking through the hall of an apartment house smelled opium fumes coming from one of the rooms. They entered and investigated, finding narcotics. The defendant's wife was present, but the defendant was not apprehended (without a warrant) until at his work the following day and was charged with unlawful possession of narcotics. The trial court quashed the information on the ground the evidence was unlawfully obtained. The District Court of Appeal reversed the judgment, saying:

> ". . . . The crime of possession of a narcotic does not require the immediate presence of the defendant so long as he has 'knowledge of the presence of the object as embraced within the concept of "physical control with the intent to exercise such control" which constitutes the "possession" denounced by the statute.' People v. Gory, 28 Cal. 2d 450, 455-456, 170 P. 2d 433, 436. Thus, if respondent, as he later admitted, had physical control of the yen shee with knowledge of its *narcotic* character, the crime of possession was being committed in the presence of the officers although respondent was not there at the time. Respondent's arrest, in view of his absence from the apartment, was made with reasonable promptness thereafter. . . ."[7]

It occurs to us this view of the sub-

3. Millea v. City of New York, Misc.2d, 204 N.Y.S.2d 260, 264 (1960).
4. 9 Am. Jur., Burglary, sec. 86; note: 103 ALR 1314, 1315.
5. Atkins v. Harris, 304 S.W.2d 650 (Tenn.—1957).
6. Atkins v. Harris, supra.
7. People v. Bock Leung Chew, 142 Cal.App.2d 400, 298 P.2d 118, 120 (1956).

ject of arrest without warrant for misdemeanors committed in the officer's presence but with the perpetrator *in absentia* opens an interesting field in which the authority may be exercised in other situations in which one may be guilty of an offense although not personally present. In an earlier article, it was shown that one may be guilty of a traffic offense as principal even though not personally present.[8] No legal distinction as to degree of guilt in misdemeanor cases is made between participants in the offense. By statute the same is true of felony in most states. Anyone having a part in it is equally guilty with the actual perpetrator. Thus anyone participating in the commission of a traffic violation is guilty as principal. Modern statutes patterned after the Uniform Vehicle Code[9] commonly provide that anyone who aids or abets the commission of a traffic offense, or who "induces, causes, coerces, requires, permits or directs another to violate" a traffic regulation is guilty as principal.

Thus, following the import of the cases cited above, one who aids and abets in the commission of a traffic violation by directing it, *permitting* it to be done, or otherwise causing or inducing its commission, is guilty even though not personally present at the time. Examples of such situations are easily conceivable, as where one places his car in the hands of an incompetent or inebriated driver and *permits* him to drive it. Of course the connection is more tangible and immediate if the owner is personally present, but this is not essential. Likewise, the owner of a vehicle would undoubtedly be guilty of speeding when his employee-driver, pursuant to direction violates the speed laws. Examples of such situations are cited in the previous article.[10] Typical of such cases of vicarious liability is the Georgia case in which the owner of one car authorized another to race it against a third person on the highway. Even though not personally present at the time, the owner was held guilty of speeding.[11]

While the issue of arrest without warrant was not involved in the cases so dealt with,[12] they serve to illustrate instances in which one might be arrested without a warrant for an offense committed in his absence by another but at his direction or inducement, in the presence of an officer.

This new concept of the arrest authority departs from the restrictive common law rule permitting arrest without warrant of misdemeanants only for offenses amounting to a breach of the peace which are committed in the presence of an officer. However, as pointed out in 4 American Jurisprudence, Arrest, sec. 26, "statutes in many, if not all, states have enlarged the right of arrest without a warrant, so that arrests may be made by police officers, town marshals, etc., for any offense committed in their presence, including breaches of ordinances and offenses not amounting to a breach of the peace."[13]

An offense is committed in the presence of the officer when he then and there acquires knowledge thereof through one or more of his five senses, or by inferences properly drawn from the testimony of his senses. As expressed by the Maryland Court of Appeal:

> "Committing an offense in the presence of the public officer embraces not only what is seen, but also, what is heard or perceived by any other sense."[14]

In another Maryland case involving this question, police officers heard loud dance music and laughter coming from an elaborate night club operating illegally, saw people "milling about" on the lawn with beer cans in their hands. The police raided the place and arrested the

8. Traffic Digest & Review, January, 1959, "Liability for Traffic Offenses of one Other Than the Driver."
9. (1956), sec. 16-101.
10. Note 8, supra.
11. Walden v. State, 73 Ga.App. 472, 36 S.E.2d 886 (1945).
12. Note 8, supra.
13. See Smith v. State, 228 Miss. 476, 87 So.2d 917, 58 ALR2d 1052 and note p. 1056 (1956); State v. Dietz, 136 Wash. 228, 239 P. 386 (1925).
14. Turner v. State, 195 Md. 288, 73 A.2d 472, 474 (1950), involving operation of a gambling table and selling beer without a license.

proprietor. In holding the offense was committed in the presence of the officers the court said:

"The term 'presence' is a word of art, denoting that before entry on the premises the commission of a misdemeanor is perceptible to the officer's senses, whether they be visual, auditory or olfactory." [15]

In still another Maryland case involving arrest without a warrant for assault, the court said:

"An assault is committed in the presence of an officer if he is near enough to hear the outcries of the victime and arrives immediately after the disturbance is over. In such a case, the officer, in determining whether or not a crime was committed in his presence, can act upon all the facts and appearances before him. Where some evidence of the commission of a misdemeanor reaches an officer through his senses, and it is augmented by other strongly persuasive facts in his possession, all of which is sufficient to convey virtual knowledge to any normal mind that the misdemeanor is then being committed, he may act upon such information as being tantamount to actual knowledge that the misdemeanor is being committed."

* * *

"It is equally clear, however, that an officer without a warrant has no authority to arrest any person for a misdemeanor, not committed in his presence or view, upon mere suspicion or belief that he is guilty. An officer without a warrant should not make an arrest for a misdemeanor unless his judgment is based upon personal knowledge acquired at the time through his senses or inferences properly drawn from the testimony of his senses, and the circumstances are such that they would justify a person of ordinary prudence in believing that the suspected person is committing a misdemeanor." [16]

An example of knowledge reaching the officer through all of his five senses is the person suspected of operating a vehicle while under the influence of intoxicating liquor, where the officer *sees* him stagger, *hears* him babble incoherently, *smells* his breath, *touches* or *feels* a bottle in his pocket, and *tastes* the contents to make sure it is liquor.[17]

However, if the officer is not cognizant of an offense being committed in his presence, even though it is actually being perpetrated within range of his senses, such as carrying a concealed weapon, it is not considered as "in his presence." In other words, unless the arresting officer has *knowledge* that the misdemeanor is taking place in his presence, he does not have the authority to arrest without a warrant, in the majority of states. As stated before, this knowledge may be provided through any of the five senses.[18]

Neither may a valid arrest be made on mere suspicion that an offense is being committed, as where officers enter a hotel room during a raid on suspicion that an offense was being committed therein.[19]

But the general rule is that in considering the legality of an arrest for an offense claimed to have been committed in the presence of an officer, the determining factor is not whether the person so charged is actually guilty but whether or not the officer had substantial reason to believe that he was committing the offense, and if substantial reason for such

15. Wanzer v. State, 202 Md. 601, 97 A.2d 914, 917 (1953).
16. Davids v. State, 208 Md. 377, 118 A.2d 636, 638 (1955); Griffin v. State, 200 Md. 569, 92 A.2d 743, 746 (1952).
17. See 4 Am. Jur., Arrest, sec. 29; Copeland v. State, 202 Miss. 509, 30 So.2d 509 (1947); People v. Belcher, 302 N.Y. 529, 99 N.E.2d 874 (1951); Robedeaux v. State, 232 P.2d 642 (Okla. Cr.—1951).
18. Brinegar v. State, 262 P.2d 464 (Okla. Cr.—1953); Amos v. State, 261 P.2d 626 (Okla. Cr.—1953); Rainbolt v. State, 260 P.2d 426 (Okla. Cr.—1953); Hughes v. State, 145 Tenn. 544, 238 S.W. 588, 20 ALR 639 and note p. 652 (1922); State v. Pluth, 157 Minn. 145, 195 N.W. 789, 791 (1923), in which the court said: "It cannot be said that a criminal offense is committed in the presence of an officer, unless the acts constituting the offense become known to him at the time they are committed through his sense of sight or through other senses. Although a person may actually be committing a criminal offense, it is not committed in the presence of an officer within the meaning of the statute, if the officer does not know it. And where the officer could not observe nor become cognizant of the act constituting the offense by the use of his senses it could not be committed in his presence so as to authorize an arrest without a warrant."
19. Ware v. Dunn, 80 Cal.App.2d 936, 183 P.2d 128 (1947).

belief exists, the courts will not second guess the officer in the performance of his duty.[20] In an assault and battery case against a constable for damages arising out of an arrest for alleged careless driving, the Supreme Court of Minnesota held it was the officer's statutory duty to determine whether acts committed in his presence constitute an offense, and if so, to arrest the violator without a warrant. The court said:

> "Therefore all that is required of an officer is that he see the acts and from them infer that they are sufficient to constitute the offense. Upon this reasoning it has been held that a peace officer without a warrant may arrest a person when the latter merely gives the appearance of being intoxicated even though it is subsequently learned that he is not."

After quoting the Minnesota statute defining the offense of careless driving, the court continued:

> "Whatever standards this language conveys, in every case it must always be the judgment of the peace officer in the first instance which determines whether or not a violation has occurred. Carelessness is synonymous with ordinary negligence, and thus, in every instance where it is alleged, a fact question is raised upon which an officer's decision is always subject to the final decision of the trier of fact. Nothing more is required than that the acts be observed and that the officer infer from them that they are sufficient to constitute a misdemeanor. The rule applies even where the alleged violator is subsequently acquitted in a traffic court, for that is of no consequence in so far as the validity of the arrest itself is concerned." [21]

In a case decided by the Supreme Court of California in 1952, a group of students had gathered to view a "hot-rod" race and some of them were arrested for unlawful assembly by officers who came upon the scene. Two of the students, Coverstone and Mock, stood trial on the charge and were acquitted, following which they sued the officers for false arrest. Reversing a judgment for the students, the Supreme Court of California said:

> "It is not disputed that the group was assembled to view a 'hot-rod' race. Such illegal purpose renders the action of the group knowingly participating therein an unlawful assembly within the meaning of section 407 of the Penal Code. When the officers arrived upon the scene, they had the authority to arrest all those engaged in the commission of the unlawful act, and in our view they were entitled to act on reasonable appearances in determining who were parties to the offense. It is patent that the officers acted upon probable cause in arresting Mock and Coverstone as members of the unlawful assembly. Such being the case, the arrests were lawful as being arrests for acts committed in the officer's presence."

The court then cites many authorities to the effect that a public offense is committed in the presence of an officer within the meaning of the common law and the statutes "when circumstances exist that would cause a reasonable person to believe that a crime has been committed in his presence." [22]

A further illustration of the right of the officer to proceed upon appearances and reasonable belief, is another California case in which a woman was convicted of bookmaking. A police officer made a telephone call to her number, conversed with her and placed a bet on a certain horse race. With other officers he then entered her apartment nearby and found her seated at a table with the telephone in her hand, with racing forms and other gambling paraphernalia in the room. While in the apartment other telephone calls were taken by the officers, and proved to be other "customers" placing bets. The question before the District Court of Appeal was as to the validity of the arrest and the admissibility of the

20. City of Miami v. Albro, 120 So.2d 23, 26 (Fla.—1960).
21. Smith v. Hubbard, 253 Minn. 215, 91 N.W.2d 756, 763 (1958).
22. Coverstone v. Davies, 38 Cal.2d 315, 239 P.2d 876, 878-879 (1952).

evidence seized as a result thereof. The court held the arrest valid, saying:

> "Penal Code, sec. 836, subd. 1, authorizes an officer to make an arrest when a public offense is committed in his presence. This simply means that such an arrest may be made when circumstances exist that would cause a reasonable person to believe that a crime has been committed in his presence (Coverstone v. Davies, 38 Cal.2d 315, 320, 321, 239 P.2d 876). Acting as they do as guardians of the peace and security of the community and concerned at all times with crime and criminals in a complex society, it is manifest that the utmost that can reasonably be exacted of an officer who arrests without a warrant is that upon the circumstances with which he is confronted, he would be justified in making a complaint upon which a warrant of arrest might issue . . . Commission of an offense in the presence of an officer is not restricted to those cases where knowledge thereof is provided by the officer's sense of sight. Knowledge of the commission of an offense may be acquired through any of the officer's senses." [23]

As stated in the Minnesota case [24] the outcome of the case in court, even the exoneration of the arrested person, does not determine the legality of the arrest. As stated by the Supreme Court of California:

> "The fact that . . . Coverstone and Mock were exonerated in the criminal proceeding has no bearing on the legality of the arrest. (Cf. Neves v. Costa, 5 Cal.App. 111, 118, 89 P. 860; Wilson v. Loustalot, 85 Cal.App.2d 316, 325, 193 P.2d 127, to the effect that the finding of guilt in the subsequent criminal proceeding cannot legalize an arrest unlawful when made. The converse would appear to be equally true.)" [25]

Most cases of arrest without warrant for offenses committed in the presence of an officer are those in which the unlawful acts are *observed* by him, thus affording him knowledge thereof through his sense of sight. Instances of this kind are so common as to need no citation of authority. It is not necessary to the commission of an offense in his presence that the acts constituting the offense take place within his normal range of vision, however, it being sufficient if he can observe them at a distance, sometimes with the aid of a telescope or binoculars. Thus where a constable observed (through a telescope) two brothers shooting burros on a distant mountainside, it was held that this, together with his observation of their vehicle loaded with dead animals upon their return to town, and their admission that they had no license, was sufficient to justify their arrest without a warrant for hunting burros without a license. On appeal the question was whether the crime of hunting without a license was committed in the presence of the officer. While it was impossible for him to see at that distance whether they had a hunting license with them, still the officer had the right to wait a more convenient time to discover this, and did discover it before making the arrest.[26]

Instances in which the commission of an offense is detected by the officer through his sense of hearing are of somewhat less common occurrence, but a number of examples come readily to mind. Thus the offense of "uttering abusive or profane language," as often found in statutes and ordinances defining "disorderly conduct," must necessarily be detected through this sense. In a recent Florida case involving such an offense the Supreme Court said:

> "Certainly the utterance of the words appearing in the testimony fall within the category of 'abusive or profane language.' The fact that they may

23. People v. Bradley, 152 Cal.App.2d 527, 314 P.2d 108, 111 (1957). See also: Catron v. Ponca City, 340 P.2d 504, 507 (Okla. Cr.—1959); Price v. United States, 119 A.2d 718, 720 (D.C.Mun.App.—1956). Contra: Muniz v. Mehlman, 327 Mass. 353, 99 N.E.2d 37, 40 (1951), holding mistaken belief not enough, however reasonable, quoting Restatement of Torts, sec. 119, comment "o".
24. Note 21, supra.
25. Coverstone v. Davies, supra, n. 22. See also People v. Burgess, Cal.App.2d, 338 P.2d 524, 527 (1959).
26. Roynon v. Battin, 55 Cal.App.2d 861, 132 P.2d 266 (Super. Ct.—San Bernardino County—1943).

have been directed to police officers would not excuse Respondents. We are of the opinion that the arrest was legal." [27]

Other examples of detecting the commission of crime through the sense of hearing are shown where officers listening outside a room or apartment hear the sound of rolling dice and conversation commonly associated with gambling, including recognition of defendant's voice,[28] placing a bet by telephone,[29] overhearing telephone conversation between sailor and prostitute,[30] standing in anteroom hearing lewd remarks coming from adjacent lodge room indicative of strip tease performance in progress,[31] and the like. In this connection, also, the offense is detected by hearing even though that sense is aided by electronic devices, such as the telephone.[32]

In the California case cited above,[33] detection of the crime of possession of opium through the officers' sense of smell was held sufficient to justify arrest of the proprietor of the apartment from which the smell emanated. In that case the court said:

"The weight of authority, with which we are in agreement, is with the view that the offense is committed in the presence of an officer 'when the officer receives knowledge of the commission of an offense in his presence through any of his senses,' . . . and this includes the sense of smell."

Cases in which the possession, transportation, and even the consumption of liquor have been detected through the sense of smell are frequently encountered.[34]

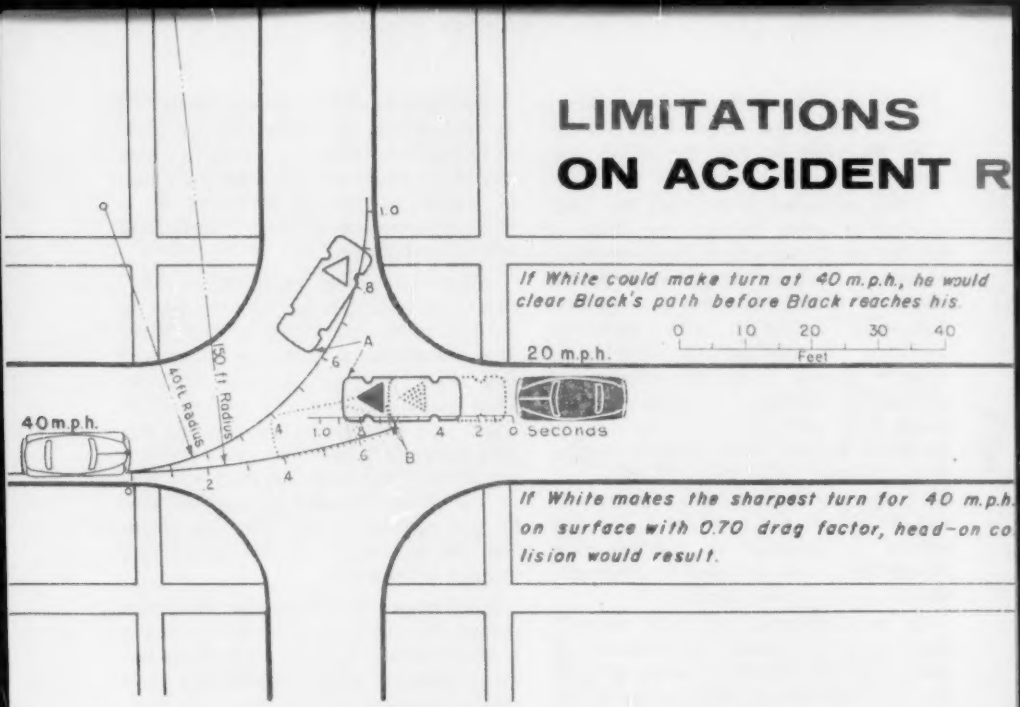
An example of how the commission of an offense may be detected by the sense of feeling is a Rhode Island case in which the officer discovered unlawful possession of liquor by placing his hand on a bulging portion of defendant's jacket and felt a liquor bottle.[35]

Another means by which the perpetration of an offense in his presence may be brought to the knowledge of the officer is by the admission of the person arrested that he is presently violating the law. Thus one's admission of having illicit liquor in a package he was carrying was held sufficient to justify his arrest without a warrant.[36] The same has been held true in case of an admission by a person that he was carrying a gun, after the officer saw the outline of the gun protruding through his shirt.[37]

They must remember also that even though the authority to arrest without a warrant actually exists in some of the unusual instances cited, nevertheless it is always advisable to first procure a warrant whenever there is time and opportunity to do so. This is a good, safe practice to follow as a general rule. It eliminates uncertainty as to arrest authority in close cases and serves to protect both the citizen and the officer from the possibility of false arrest. However, situations occasionally arise when the officer must act on his own initiative on the spot or allow an offender to escape justice. It is in these circumstances, to prevent law violators from escaping and thereby defeating justice, that he is granted the power to arrest without a warrant, and he should be aware of the nature and extent of such authority and use it wisely. ★

27. City of St. Petersburg v. Calbeck, 121 So.2d 814, 816 (Fla.—1960). See also, 4 Am. Jur., Arrest, sec. 31; note: 34 ALR 566.
28. Davis v. Commonwealth, 280 S.W.2d 714 (Ky.—1955). See also, State v. Rhoten, 174 Kan. 394, 257 P.2d 141 (1953).
29. People v. Bradley, supra, n. 23.
30. People v. Cahill, 163 Cal.App.2d 15, 328 P.2d 995 (1958).
31. Bass v. State, 182 Md. 496, 32 A.2d 155 (1943).
32. People v. Bradley, supra, n. 23.
33. People v. Bock Leung Chew, supra, n. 7.
34. Carroll v. State, 189 Tenn. 351, 225 S.W.2d 532 (1949); Harris v. State, 216 Miss. 895, 63 So.2d 396 (1953); Brown v. Commonwealth, 208 Ky. 345, 270 S.W. 833 (1925); State ex rel. Hansen v. District Court, 72 Mont. 245, 233 P. 126 (1925).
35. State v. Chester, 46 R.I. 485, 129 A. 596 (1925).
36. State v. Gulczynski, 32 Del. 120, 120 A. 88 (1922); Royce v. Commonwealth, 194 Ky. 480, 239 S.W. 795 (1922); Patterson v. Commonwealth, 206 Ky. 258, 267 S.W. 160 (1924); Williamson v. State, 140 Miss. 841, 105 So. 479 (1925); State v. Secrest, 131 Wash. 217, 229 P. 744 (1924). Contra: Allen v. State, 183 Wis. 323, 197 N.W. 808, 39 ALR 782 (1924).
37. Johnson v. Commonwealth, 304 Ky. 490, 200 S.W.2d 913 (1947).

LIMITATIONS ON ACCIDENT R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150 ft Radius
40 ft Radius
0 Seconds
If White makes the sharpest turn for 40 m.p.h. on surface with 0.70 drag factor, head-on collision would result.

A better understanding of the limitations of accident reconstruction may make the techniques more useful in learning how to prevent accidents

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FIRST OF TWO PARTS

HOW PRECISELY an investigator can determine how a traffic accident happened depends on the completeness and reliability of the information available, on the skill of the investigator in recognizing pertinent facts in the available information and on his ability to deduce from the facts the position and motion of traffic units involved during the accident. Usefulness of such reconstruction depends on whether the precision achieved is sufficient to meet needs as determined by the purposes of the investigation.

The traffic accident investigator, whether he be a policeman, a claims adjuster, an attorney, a fleet supervisor, or a scientist probing for causes of accidents, first gathers all the information that seems to be readily available. While doing this, he seeks an unbiased witness with keen powers of observation, an advantageous position from which to observe the events, and a prodigious memory for detail. If he finds such a priceless treasure, his troubles are at an end. The witness can explain. If he does not have such good fortune, he has to sit down to the tedious task of sifting

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through bits and fragments of information to sort out what seem to be relevant facts. From these, like an archeologist piecing together the story of some past culture from remaining ruins, he tries to reconstruct events of history; but unlike the archeologist, he is focusing his attention on a few brief seconds in the recent past.

Sometimes the investigator can fit his facts together so neatly and completely that the picture of what happened is clear for all to see. Usually, however, only parts of the picture appear in the assembled data. There are blank areas which must be sketched in from experience or by deductive reasoning. If the blank areas are too numerous or too important, the task of completing the picture of the accident may have to be abandoned.

Data Stimulates Idea

In other words, from available information an idea is formed about certain brief happenings in the series of events that constitute the accident. In case studies of accidents by scientists, this idea may lead to an hypothesis about factors contributing to accidents to be explored in other cases or by experiment. In contrast, prosecuting or plaintiff's attorneys may take a short cut to find "a theory" by saying to themselves, "If I could only prove illegal speed or encroachment on the left half of the road!" Then facts are sought to support the desired theory.

If facts readily discoverable fail to yield a satisfactory theory, someone more expert may be sought to help with reconstruction. This person must have special experience that gives him skill to find in the available information hitherto undetected facts. He must also have training that gives him knowledge to deduce from these facts the circumstances which will prove or disprove a theory. But regardless of who does it, or for what purpose, "reconstruction of a traffic accident is determining from known facts how the accident happened."

Purpose of This Article

The object of this discussion is to explain the more important limitations on accident reconstruction, but it will inevitably also suggest possible effective uses of this technique. The article will have served its purpose if it can bring into focus factors to be considered in evaluating proof required for a "theory" about the circumstances of an accident.

To put it another way, let us ask some pertinent questions which we can then try to answer. First, what determines how accurately we can estimate accident circumstances, for example speed or transverse position of the vehicle on the road just before its driver detected danger? Second, how precise does such an estimate need to be? These questions will not be considered as related to observational ability, or memory, or veracity of drivers or other witnesses. They will be considered in relation to results of the accident such as damage to vehicles, marks on the road, and positions of vehicles where they came to rest after colliding or running off the road. This approach is taken because estimates of circumstances connected with the accident are so often used to support or contradict conflicting versions of the same accident offered by various participants or witnesses. Furthermore, the degree of precision required of conclusions to be formed by accident reconstruction will often be determined by the amount of difference between opinions of participants.

In general we may say that what anybody, expert or otherwise, *can do* in reconstructing an accident depends on two things: first, the *material* he has to work with, and second, the *equipment* he can use for the task. How far a person *actually will* go in trying to reconstruct an accident is determined by two more things: first, just *what he wants or needs to know* and, second, *how much time* he can afford to spend on it. The engineer, physician, or behavioral scientist may

want to know all about the accident; he may be willing to spend days probing the case. On the other hand, a policeman may wish to know only whether a certain law was violated; he may have only a few minutes for investigation.

Materials Used for Reconstruction

The "material" used in reconstruction is the information available. With enough reliable information nearly anybody with reasonably sharp wits can satisfactorily sort out the facts and figure out how the accident happened. With insufficient or unreliable information nobody, however astute, can produce more than vague speculation about the events of the accident.

This may be illustrated by an example. Let us say we wanted to know how far it would take a car to stop. We have the information that it was a 1960 Buick four-door sedan in good condition, on a black-top road. The information is reliable, probably, but insufficient. Nobody can tell from it how far it would take the car to stop. The car might stop in one foot or a thousand feet depending on how fast it was going and how the brakes were applied. If we add that the car was going 40 to 50 m.p.h., that the brakes were applied hard enough to lock the wheels, and that the pavement was level, dry, and clean, an estimate is possible if one knows how to go about making it. A pavement of this description has a coefficient of friction between 0.40 and 0.75. With a speed of 40 m.p.h. and an average coefficient of friction of 0.75, the stopping distance would be close to 70 feet; but with the other combination, speed 50 and coefficient of friction 0.40, the distance would be about 206 feet. Thus we could say "the estimated stopping distance would be between 70 and 210 feet." The data supplied are not accurate enough to give a more precise estimate. If the speed is specified as exactly 50 m.p.h. and the pavement is described as a light gray asphaltic concrete, or appears to be such in photographs, the estimate of stopping distance can be narrowed to something like 120 to 150 feet. Finally, if test skids are made to determine the coefficient of friction, an estimate of 130 to 145 feet might be made. It would be difficult to make a more precise estimate because so many conditions, such as tire air pressure, air temperature, vehicle weight, tire tread pattern, wind velocity, and wind direction, all may have minor effects and cannot be precisely measured or observed at the time and place of the accident by the people there. Whether the estimate is accurate enough depends on the purpose for which it is made as will be explained later.

"Equipment" for Reconstruction

Such mechanical tools for reconstruction as tables and charts of stopping distances of motor vehicles[1] are far less important to whoever tries to reconstruct an accident than two kinds of mental "equipment":

1. Ability to recognize signs of what happened in the results of the accident.
2. Knowledge of certain principles of geometry and some of the sciences such as mechanics, optics, and psychology.

Ability to Recognize. Anybody who has had some experience with highway traffic can recognize the more obvious clues as to what happened. For example, who would not recognize a pair of long dark smears on the pavement five feet apart and parallel as skid marks? But few have had the experience, done the studying, or conducted the experiments to permit them to recognize obscure signs. How many, for example, can tell by examining a shattered tail lamp after a rear-end collision, whether the bulb was burning at the time it was broken by collision?

By case studies of accidents, investigators continually increase knowledge of how to recognize the significance of signs left by the accident and statements made about it.

[1]See Baker, James Stannard, "Practical Use of Speed Charts." Defense Law Journal, Vol. 2, p. 156. Allen Smith Co., Indianapolis, Indiana. 1957. Also, "Charts and Tables for Stopping Distances," Traffic Institute Publication No. 0022.

Often, investigators with a little general knowledge make mistakes by identifying some mark on the road or damage to a vehicle as something it looks like, but is not. For example, it is not uncommon for someone to notice a pair of dark tire marks on the pavement leading to a spot where an accident occurred and think they are skidmarks when they should have been recognized as imprints of oil and dirt picked up by tires from a puddle and laid down by a vehicle leaving the location after damaged cars have been removed. Even fairly experienced investigators may not recognize more than two or three kinds of skidmarks or the difference between a skidmark and a scuff left by a tire on a rotating wheel sliding sidewise a little. And if he does recognize the scuff for what it is, the investigator may not see any particular significance in the angle of the minute striations of which a scuffmark is made up.

Knowledge of Principles. Nearly everybody familiar with traffic can also draw some obvious conclusions about how an accident happened from the results of the accident. For example, suppose one car is damaged heavily in the rear and another, which collided with it, is damaged heavily in front. Nobody has any difficulty in concluding correctly that there has been a rear-end collision. But without other information than knowledge of the damage, it may not occur to some people that the front car may have been backing. Knowledge of how vehicles or other objects behave when in motion helps immensely in concluding correctly what happened in an accident. Everybody knows, that a car moving fast will take farther and more time to stop in an emergency than one traveling slowly; but some knowledge of mechanics is necessary to estimate how fast the car would have to go to slide to a stop in a certain distance.

Some of the knowledge about vehicle behavior is embodied in special published formulas.[2] Without these, people who do not know the principles involved may, by using an appropriate procedure, make useful estimates. Thus, in the emergency-stop example just cited, one may know that the distance to stop a vehicle by sliding can be estimated by the formula $D = S^2 / 30 (F + G)$ in which D is distance in feet, S speed in miles per hour, F coefficient of friction of tires on roadway, and G grade or rise in feet per foot of horizontal distance. Yet the person who uses this formula may not know the principle on which it is based: an object sliding on an unobstructed, level surface continues to slide until its energy of motion is all changed to heat energy by friction; and if the surface slopes up, part of the energy of motion is changed to heat and part to potential energy by raising the object. The formula user may also not know that unless all wheels slide, the F in the formula is not the coefficient of friction between tires and road, but a drag factor which depends on how much pressure a driver applied to the brake pedal and other circumstances about which there may be no reliable information.

The investigator who can select from his knowledge and apply basic principles has an advantage over one who has only limited formulas or tables and charts which represent the formulas. He can estimate, for example, not only the stopping distance from the usual speed-skid formula, but also the stopping time. In some reconstructions time may be as important or more so than the distance, but the formulas for time have not been so widely published.

Another illustration of increased accuracy of forming conclusions when the investigator has better "equipment" with which to work may be helpful. At an intersection, after sliding four wheels 50 feet, Black strikes White amidships. White is standing across Black's path in the intersection as illustrated in Exhibit 1. After collision, both cars slide 30 feet, Black continuing forward and White sliding sidewise. When they come to rest they are engaged. Black weights 4000

[2]Baker, J. Stannard, *Traffic Accident Investigator's Manual for Police*. Traffic Institute, Northwestern University, Evanston, Ill., 1957.

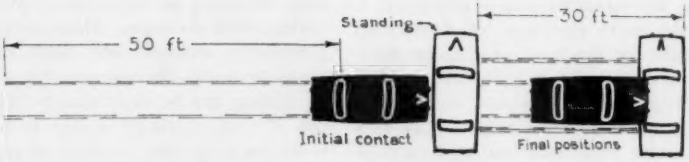

EXHIBIT 1. Estimates of Black's speed should take into account White's movement.

pounds, White 3000 pounds. The roadway has a drag factor of 0.7. We want to know Black's speed before he took evasive action by braking.

Investigator A, who knows only how to estimate speed from skidmarks before collision, uses a formula to estimate that Black would need a speed of 32 m.p.h. to slide to a stop in 50 feet. He would then say, "Black was going more than 32 m.p.h." How much more he would not be prepared to state because he has not been able to consider damage or movement of cars after collision.

Investigator B, realizing that Black slid a total of 50 + 30 = 80 feet, could estimate Black's initial speed, using the same formula, and say," Black was going more than 41 m.p.h. He would require at least that speed to slide to a stop in 80 feet." How much more speed would be needed by Black to slide White sidewise he would not be able to say.

Can Compute Energy

Investigator C knows how to compute the energy required to slide White sidewise 30 feet and adjust Black's speed to include this additional energy. He can say, "Black was going more than 46 m.p.h." He has considered more of the information, but, like the others, has not been able to embrace the damage done to the vehicles in the speed estimate.

Investigator D, in addition to knowing what the others know, also knows about the conservation of momentum, and therefore, without knowing exactly what the damage amounts to can take it into consideration. He can say, "Black's speed was 55 m.p.h., give or take a few miles per hour." He is the only one who has been able to use all of the available pertinent data.

Note that although their estimates differ in certain respects, there is *no disagreement* among these investigators. They all agree that the speed was more than 32 m.p.h.; and all would agree that the first three have not accounted for all of the loss of energy. The difference between them is in the precision of their estimates. It might be that, for the purpose required, the least accurate estimate would be sufficiently precise. Suppose, for example, that the estimate was made to show whether speed was above a legal limit of 25 m.p.h. Investigator A's estimate would do this. But general circumstances of the collision even without an estimate, would leave little doubt in anyone's mind that Black's speed was more than 25 m.p.h. and so such a rough estimate would serve little practical purpose.

Case studies of accidents have frequently called for the application of old principles to new kinds of problems and so have gradually augmented general knowledge of the possibilities and limitations of accident reconstruction.

What Accuracy Is Required?

So far we have considered kinds of factors which determine how accurately conclusions can be drawn in reconstructing accidents. Precision in such thinking, as in other work, depends on the material with which one has to work—in this case the information available—and on the sharpness of the "tools" at hand for working the material—in this instance the ability to recognize information for what it means and knowledge of principles that can be brought to bear on the problem.

Next, let us consider what accuracy is required. How precise an estimate needs to be depends on what it is to be

used for. A rough estimate may be quite useful under some circumstances and a highly accurate one not good enough in other conditions. Again this may be clearer in an example.

Black and White collide head-on on a straight level road 22 feet wide. Both cars are six feet wide. Therefore, if each car was entirely on its own half of the road, there would have been no collision. Because there was a collision, we must conclude that one or both of the cars was encroaching on the left half of the road. This illegal act may be presumed to constitute negligence. Therefore, the problem of reconstruction is to determine transverse position of the cars on the road at the time of collision.

The following information is all that is available to work with:

1. Direction of travel of the cars preceding collision: Black is southbound and White northbound.
2. A group of heavy gouges in the road surface. See Exhibit 2A. There is agreement that these were left by the cars during collision.
3. Damage to the left front corner of each car.

From observations or photographs of the damage to the cars, we can determine that the part of whichever car left the gouges must have been on the underside in the area shown in Exhibit 2B by a dotted outline. This damage is inside of the left front wheel and not more than a few inches to the right of the center of the car. From the damage we can also determine fairly accurately how much the front ends of the cars overlapped during collision. This would place the cars *with respect to each other other* during collision as shown in Exhibit 2B. If something at the extreme east side of the possible damage area on White's car left the gouges farthest to the west, the cars would be in the positions shown to the left in Exhibit 2C; but if the extreme west side of Black's damage left gouges farthest to the east, the positions would be as shown to the right in Exhibit 2C. The best we can do, therefore, with the information available is to locate the cars laterally on the road within about eight feet.

This is not very accurate; but is it accurate enough to determine which car was on the wrong side of the road? That depends on where the gouges are on the road. If we know only that they are "all in the east half of the roadway" they might be as far toward the center as in Exhibit 3D. Under this circumstance the location of the cars might be as far to the west as the W positions or as far to the east as the E positions. Then Black might have been completely on either side of the centerline and White might have been as much as four feet to the left of the centerline. The conclusions which we can make from the available data are not sufficiently accurate. They

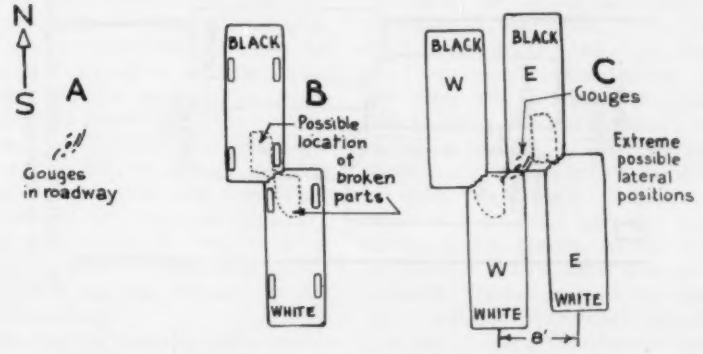

EXHIBIT 2. (ABC) Lateral position determined by gouges in road and damage on vehicles.

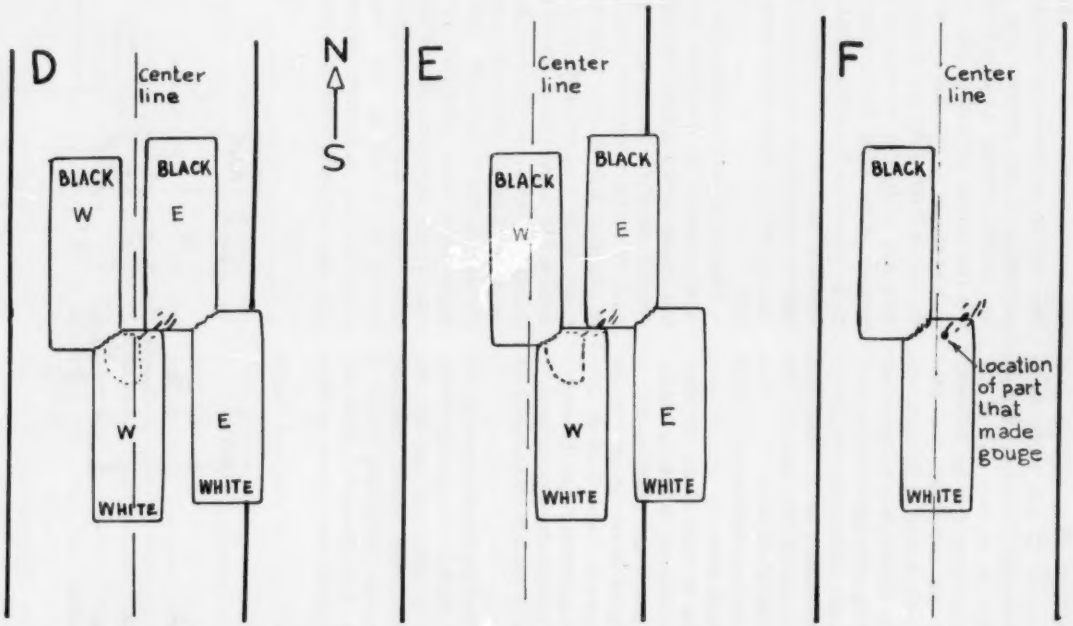

EXHIBIT 3. (DEF) Greater precision in determining lateral position results from matching gouge with part of car that made it.

are useless to answer the question that we want answered.

Suppose, however, that the cluster of gouges was located accurately by measurements at their position in Exhibit 3E, a little to the east of the center of the east lane. Then we could say that even with the cars as far to the west as possible White would be completely on his own side of the road, and if they were in the extreme east position, he might be nearly off the road on the right shoulder. So, even without knowing precisely what part of which car left any of the gouges, the information is accurate enough to answer the question. Had the gouges been located two feet farther west, we would not say positively that White was or was not on his own side but we could say that regardless of White's position, Black was definitely over the centerline.

Comparing Elements

Finally, suppose that the investigator carefully examined the underside of each car and discovered a heavily abraded nut on a bent stud nine inches to the right of the center of White's car. He measures the nut and compares it with the gouges in the roadway. It is the only part of either car that is of such a size and damaged in such a way as to leave the groove farthest to the west. Now, the location of the car at the time the groove was made can be determined within a few inches. From the overlap of the cars as determined from the examination of damage, its position with respect to the other may also be determined within a few inches. If the gouges have been carefully located on the road at the position shown in Exhibit 3F, the car positions would then be within about six inches of those shown and we could say that Black definitely was on his own side of the road close to the centerline and that White was straddling the centerline. Thus, the accuracy with which we need to know what part of a car left the mark on the road depends on the location of the marks on the road.

Recall also the example given earlier of estimates of stopping distance from 50 m.p.h. based on various amounts of information. Suppose that the driver could have seen a pedestrian and have got his foot on the brake when he was 160 feet away. Then the question to be answered will be whether he could have taken successful evasive action in this distance. The first crude estimate of a stopping distance, between 70 and 210 feet, is not sufficiently accurate for the purpose, although it might be accurate enough for other purposes. The second estimate of 120 to 150 feet would be sufficiently accurate, and of course the third estimate, 130 to 145 feet, would be still more convincing that the driver could have taken successful evasive action in the 160 feet available to him. Had the sight distance been 140 feet, none of the estimates would have been precise enough to prove whether he could or could not have stopped in that distance.

Accuracy of conclusions from reconstruction of accidents for purposes of determining what trafficway, vehicle, or personal conditions were factors must be far greater than accuracy for determining whether there is proof of a law violation.

Unsolvable Problems

Availability of information about traffic accidents being what it is, many attempts to reconstruct accidents will inevitably fail. A reconstruction succeeds or fails depending on whether conclusions that the investigator can make from facts available to him are sufficiently accurate to answer the critical questions. These questions are determined by the purpose of the reconstruction, whatever that may be. Basically all reconstruction failures arise from lack of facts. If enough facts were available, how the accident occurred would be obvious to anybody and reconstruction in a technical sense would be quite unnecessary. Accident reconstruction is half art, perhaps, and half science, but it cannot honestly perform the miracles which some seem to think it should. Yet investigators are again and again hopefully presented with reconstruction problems for which no practical solution can be expected from anybody.

For example, numerous photographs

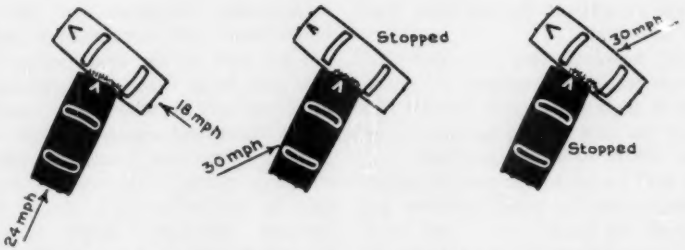

EXHIBIT 4. Same damage can result from various car movements before collision.

are produced showing damage to two cars, Black and White, which have collided. How fast was each of the two going? That question cannot be answered from examination of damage alone. Well, then, which was going faster? No answer to that question either. How about which car hit which? No way to tell from the damage. The fact is that the identical damage could have been done with Black moving and White standing, with White moving and Black standing or with both moving as indicated in Exhibit 4. Some of these situations may involve sliding sidewise or spinning, but there is nothing impossible about that which would be apparent from the damage alone. There are only a few unreliable clues in damage to suggest which car was going faster in a two-car accident. Other information, however, used in connection with information about damage does make possible useful conclusions concerning speed.

Another question to which there is rarely a useful answer: how fast was a car going if it "threw" or "tossed" a pedestrian a certain distance? If we knew also how *high* the pedestrian was thrown, an estimate might be made. Or if we knew how far the person *slid* on the road after being hit by a car, the car's speed can be estimated often to a useful degree of accuracy. The speed of the car cannot be determined from how far the car "dragged" or "carried" the pedestrian after collision. We also need to know that the car skidded to a stop or was braked to a known rate while dragging the pedestrian.

How fast was a car going if it stopped in a given distance without skidding? The speed might be almost anything from that required to coast the distance, to a speed a little higher than would be required to skid to a stop in that distance. It depends on how much pressure is applied to the brakes. If stopping tests are made with the car and driver under the same or closely similar conditions some approximation of the speed may be made, but it may not be accurate enough for the purpose intended.

Another common type of indeterminate problem involves a collision at an intersection. The northbound car collides with the eastbound. The first came to rest 50 feet from the "point of impact," and the second 100 feet. How fast was each going when they collided? Either car might have been standing still and still have the collision result in this movement from the point of first contact. It is much more important to know the *direction* of travel after collision than it is the distance. Usually some other facts are also needed, especially the directions of approach to the key point, damage to each vehicle, and its weight. The importance of precise information about direction will be emphasized in an example reconstruction given later.

Estimates of distances at which objects may be seen at night are usually so lacking in preciseness as to be almost worthless. There are many factors involved and the information concerning any of them is likely to be extremely vague. Hence the estimates must be equally vague. Often experiments with

similar objects under similar conditions are the simplest way to determine seeing situations at night. Such experiments are usually difficult to make, but may be very convincing.

Reports of rear-end collisions usually lack some critical fact which is necessary to determine whether the front car was stopped or slowing rapidly or whether the rear car was overtaking at a great speed. Actual speeds are likely to be very difficult to estimate to any useful degree or accuracy, because the same damage could have occurred with approximately the same *difference* in speed at quite a range of speeds. Thus if the leading car were going 10 m.p.h. and the following car 20 m.p.h., a difference of 10 m.p.h., the damage would be about the same as if the leading car were going 30 and the following 40 with the same 10 m.p.h. difference.

More Information Possible

When reconstruction presents unsolvable problems because of lack of information available at the time, it is often possible to get more information. Dimensions of the highway at the location usually remain the same for many years. They may yield essential measurements on sight distances, placement of traffic control devices, clearances, curve radii, superelevation, and so on. Gouges in the road surface and damage to fences or guardrails may be observable long after the accident. Damaged vehicles may be usefully studied until they have been repaired or junked.

Additional useful information may also be available from participants in the accident or witnesses. Often the wrecker or ambulance drivers can give information about final positions of vehicles and injured persons or about rescue and removal operations which may have done additional damage to the vehicle or have left marks on the road. Drivers and other occupants of vehicles may later furnish dependable information about trip plans, vehicle condition, and other matters that were not available in early reports. Drivers' statements about events of the accident are likely to be incomplete, confused, or actually misleading to begin with. Unfortunately, they do not improve with time. Memory tends to fade and interest to warp the impression of what happened.

Practical Problems

Besides the familiar speed estimates from skidding distances, many kinds of reconstruction problems can be solved from data which are usually obtainable. For example, there may be clear signs that a vehicle has left the ground before collision and traveled through the air. Then if the distance is known, its take-off speed can be estimated, or at least a lower or upper limit may be determined for it. Careful measurements of slope of the road at the take-off point and other elements of the highway may be required for this purpose.

If speed and braking distance is known and there is reason to believe that brakes were applied as stongly as possible, ability of brakes to meet minimum legal performance standards may be determined. But this is not possible if skidding occurs on a slippery surface. Often however, speed and stopping distance are not known accurately enough to give an estimate of the required precision.

If two vehicles traveling side by side at about the same speed come in contact, it is possible to tell which car could have "forced" the other physically into another lane or off the road. Weights of the vehicles must be known to do this and sometimes also the distribution of weight between front and rear wheels.

Speed required to make a car slide sidewise on a curve can usually be estimated to a useful degree of accuracy. The path followed by the car must be known from scuffmarks or other marks, and certain characteristics of the road surface at that place must also be determined.

Problems of sight distance at crests of hills or where there are horizontal view obstructions at junctions or curves can usually be worked out satisfactorily. Measurements of the trafficway alignment and vehicle dimensions are needed.

EXHIBIT 5
Contradictory Statements of Drivers About Speeds

Statement by	Speed in mph		Ratio of Speeds
	Of car	Of truck	Car/Truck
Car driver	15	45 - 50	0.34
Truck driver	50 - 60	25 - 30	2.00

Often tests at the location with similar vehicles are helpful in establishing the exact point at which the driver of each vehicle could see the other.

To illustrate how each of these kinds of problems is solved is beyond the scope of this article. One case will exemplify both identification of data and its interpretation. It will also further suggest the general limitations and possibilities of reconstruction.

At an intersection, a northbound car collided with a westbound truck. Statements of the drivers gave speeds of the vehicles as shown in Exhibit 5.

Problem Is Speed

The problem is to determine whether the truck or the car was exceeding the 30 m.p.h. speed limit and whether the car could have stopped before entering the intersection. With only the statements in Exhibit 5 to go by, the investigator is forced to fall back on evaluating the honesty of those making the statements to determine which statement is correct. Under these circumstances, conclusions would be little more than guesswork.

Fortunately, damage to vehicles, their final positions, and marks on the road were adequately photographed. Unfortunately no measurements were made by the original investigators. Later, an accurate map of the location showing all tracks and cracks in the pavement was prepared. From photographs, marks on the road left by the accident and final positions of the vehicles were located on the map by a rudimentary form of ground photogrammetry, which is making maps from photographs. This resulted in the factual, after-accident map of the situation shown in Exhibit 6. Such a map is the usual first step in a reconstruction which works back from the results of the accident.

Examination of Vehicles

The second routine step is examination of the vehicles, or photographs of them, to prepare factual patterns showing damage as at A and B in Exhibit 7. Examination of the final positions of the vehicles shows that the truck had secondary damage from the utility pole and the car from collision with a parked car. This leaves the right front of the car and the left front of the truck with primary collision damage to indicate the relationship of the car to the truck during collision.

Minute examination of damage will determine the direction of major thrust in the primary collision on each vehicle. It will also show the approximate point at which this thrust was centered. These thrusts are shown on the patterns of the vehicles at A and B in Exhibit 7.

Because the force of each object against the other is equal and opposite at all times during collision, these thrust arrows on the vehicle patterns can be placed opposite to give the position of the vehicle at maximum engagement as at C in Exhibit 7.

The thrust against each vehicle by the other is highly eccentric; that is, it is directed considerably to one side of the center of mass of the vehicle. Therefore the force will cause the vehicle to rotate.

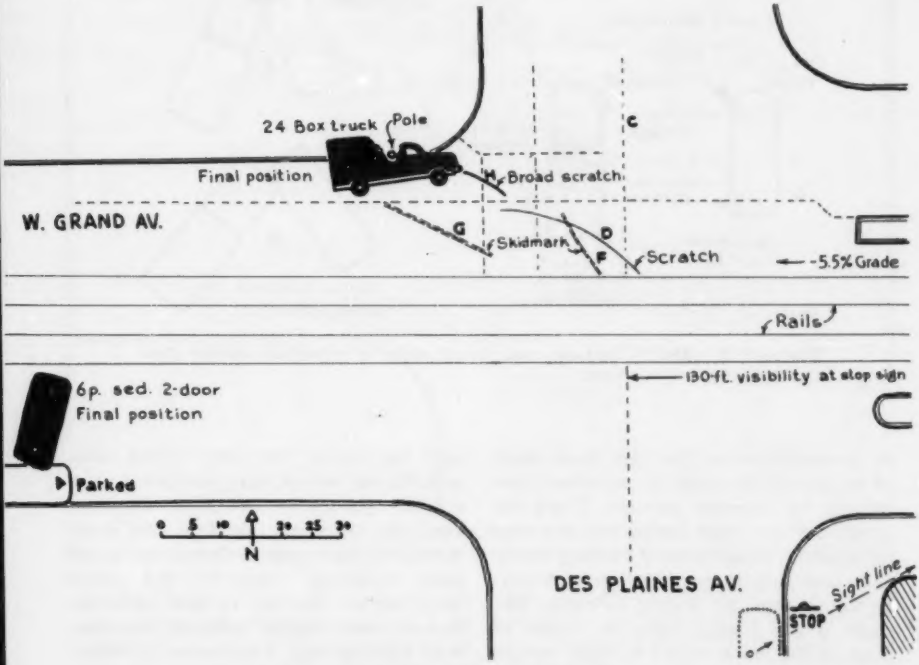

EXHIBIT 6. After-accident situation map.

The truck will rotate clockwise and the car in the opposite direction. It follows, then, that at initial contact the angle between the vehicles would have been greater than at maximum engagement. Their positions relative to each other would then be close to that shown at D in Exhibit 7.

Study of marks on the road identifies the broad skidmark at F in Exhibit 6 as being left by a tire moving mostly sidewise. The mark begins close to the north rail of the streetcar tracks. Further examination of the photos of the truck luckily show a scuffed area on the right front tire corresponding to this skidmark. Hence, we can determine very accurately the position of this wheel of the truck when, after entering the intersection west-bound, its front started suddenly to move northwest or toward the truck's right. Such movement can only be produced by an external force. This must have come from impact with the car. Having established positions of the vehicles with respect to each other at initial contact as at D in Exhibit 7, we can now place them on the road at the key or collision positions as in Exhibit 8. This gives logical approach positions for both vehicles. The car driver apparently swerved to the left half of the road upon seeing the truck, a natural evasive action. The truck was in a normal transverse travel position in the roadway and if evasive action was taken it was braking rather than steering, although the braking was insufficient to leave skidmarks.

The broad scratch H in Exhibit 6 is easily accounted for by the metal edge of the truck bed which shows conspicuous abrasion marks. The skidmark G can

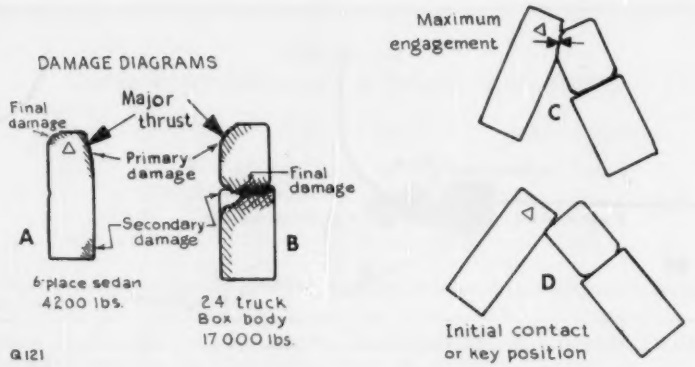

EXHIBIT 7. (ABCD) Damage and thrust patterns establish relative positions during engagement.

be accounted for by the right front wheel of the car which would be prevented from turning by collision damage. Clockwise rotation of the truck during and just after engagement would place it heading northeast, crosswise to its direction of travel. It would thus be sliding sidewise. Because it was loaded high, the center of mass of the truck would be high enough compared to the truck's tread width that the truck would turn over in sliding sidewise on a pavement with a coefficient of friction like that at this point. As it turned over, the truck would fall on the trunk of the car, doing the damage noted there in Exhibit 7A. The position of the second collision of the two vehicles is shown in Exhibit 8. We now have a fairly accurate idea of how the vehicles moved during the accident. All resulting damage and marks in the road have been satisfactorily accounted for except the long scratch at D in Exhibit 6. This may have been left by removal operations.

During engagement, each vehicle deflected the other from its course. Before disengaging the two vehicles traveled together in the same direction for some distance. This is shown by the dashed lines representing the paths of the centers of mass of the vehicles in Exhibit 8. Had the truck been standing, the car would not have been deflected from its path but would have been swung aside, and the car would have continued in its original generally northward direction. Had the car been standing, the truck would not have been deflected but would have continued westward and would have moved the car in that direction. Because each vehicle deflected the other, both were moving. The amount of deflection of each would depend on its momentum compared to that of the other.

Exhibit 9A is a diagram of the direction of movement of the vehicles as each approached the collision point from a different direction. The direction in which the vehicles left the collision point while engaged is also shown. The momentums of the vehicles before collision must have been such as to produce the direction of movement after collision. The relative momentums before collision may be worked out by a vector parallelogram with sides parallel to the paths of approach of the two vehicles and the diagonal in the direction of common departure from collision. Now, the momentums of the two vehicles before collision must be such in direction and magnitude as to produce movement in the new direction after collision. The directions are known. The magnitudes must be proportional to the sides of this vector parallelogram. Choose any arbitrary scale to measure the sides of

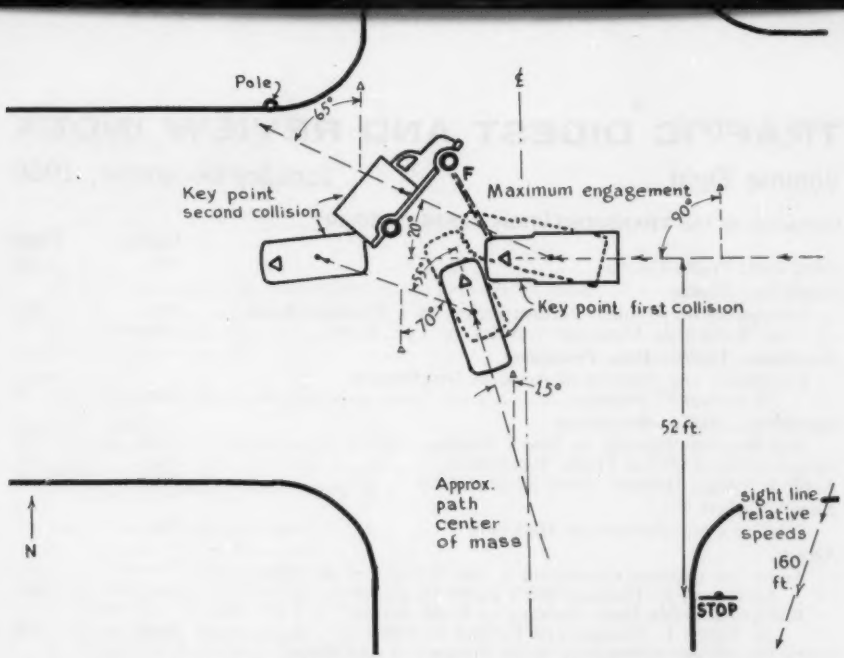

EXHIBIT 8. Diagram of movements during accident.

this parallelogram and the ratio of the momentums can be computed. In B of Exhibit 9 the side of the parallelogram representing the momentum of the car measures 1.85 and that of the truck measures 4.5. Then

$$\frac{\text{Momentum of car}}{\text{Momentum of truck}} = \frac{1.85}{4.5} = 0.41$$

This means that the car has 41 per cent as much momentum as the truck.

Momentum is the product of speed and weight. Hence the expression above can be rewritten in terms of the speeds and weights of the truck and car. Thus:

$$\frac{\text{Speed of car} \times 4200 \text{ lbs.}}{\text{Speed of truck} \times 17000 \text{ lbs.}} = 0.41$$

Transposing:

$$\frac{\text{Speed of car}}{\text{Speed of truck}} = 0.41 \frac{17000}{42000} = 1.7$$

This means that the speed of the car was 1.7 times the speed of the truck or that the car was going 70 per cent faster than the truck. This figure is not, of course, highly accurate, but it would be safe to say that the car speed was between 1.5 and 2.0 times the speed of the truck.

In the light of this conclusion from reconstruction, let us examine the statements of the drivers as recorded in Exhibit 5. The truck driver said that the car was going twice as fast as he was. This 2.0 times is not far from the 1.7 times estimated from the reconstruction, therefore the truck driver's statement is generally confirmed. The car driver, on the other hand, said that he was going only a third as fast as the truck. This stated 0.34 is far from the 1.7 and so we can reject the car driver's statement. Had the accident occurred as the car driver claimed, the momentum of the truck with its greater weight would have been so much more than that of the car, that both vehicles would have moved almost straight west after collision and very likely the truck would have remained upright. ★

(Part 2 of this two-part article will be published in the January issue of Traffic Digest and Review.)

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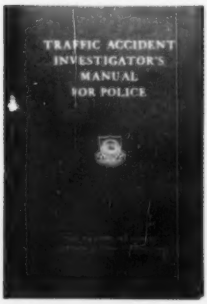

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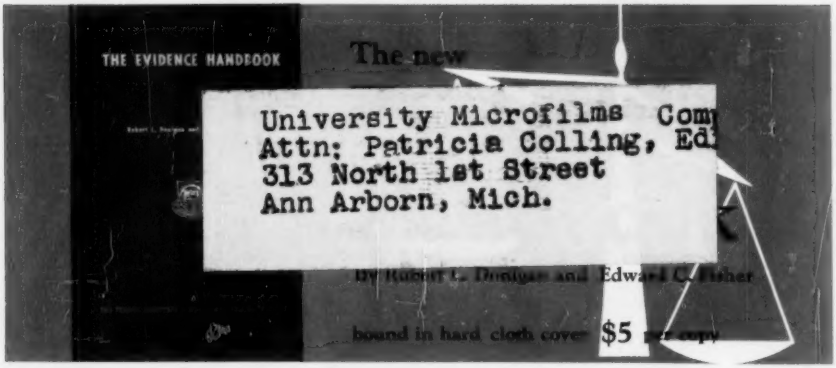
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Although retaining the clarity and concise style of the original, the authors revised and expanded the contents to give the book a broadened scope and greater depth, making it more useful to the law enforcement officer as a training text and to judges, prosecutors, and lawyers as an authoritative reference source.

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Background • Evidence Defined and Described • Admissibility and Weight Distinguished • Relevancy and Irrelevancy • Materiality and Immateriality • Competency and Incompetency of Evidence and Witnesses • Impeachment of Witness • Judicial Notice • The Burden of Proof • Presumptions.

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